

deciding to adopt this type of construction in any given case. An excellent index adds much to the value of this book for reference purposes, which will prove a welcome addition to the library of every architect and civil engineer.

T. H. B.

Waterworks Management and Maintenance. By W. D. Hubbard and Wynkoop Kiersted. Pp. vi+429. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 17s. net.

THIS book is divided into three parts, the first dealing with the methods and principles of developing, improving, and storing water supplies; the second with the maintenance and operation of waterworks; and the third with water rates, and depreciation and valuation of waterworks property.

Although this book treats of American practice, and cannot be regarded as a text-book for experts, yet it contains a great deal of information useful to those having the designing and management of waterworks for urban districts.

The authors point out that in selecting a source from which a supply can be obtained a knowledge of the physical characteristics of the territory from which the water is to be obtained is the first consideration; a chemical analysis is necessary to detect impurities; and as drinking water is a medium through which the bacilli of certain diseases may be imbibed, and infection thus widely disseminated, a rigid bacterial examination has now become a recognised necessity.

Chapter i. treats of ground water supply and wells, the percolating capacity of soils, rate of filtration through sand, and purification works. The second chapter deals with water supply from rivers, and the means of fitting it for domestic use. The third chapter describes the class of engines in use for pumping, the other chapters treating of plans and records, service connections, meters and fittings, fire protection, financial management and accounts, water rates, and depreciation.

Attention is directed to the subject of electrolysis, or the effect that the introduction of street railways worked by electricity has had on the water mains; and illustrations are given showing the effect of electrolysis on the cast-iron mains. As a result of electrolytic action the metal of the pipes becomes in some cases so softened that it can be cut with a knife. Cast-iron is affected the least, wrought-iron next, mild steel the next, then high carbon steel, and lead the most. The salts in the ground also have a varying effect, the order of activity being chlorides, nitrates, and sulphates. The drier the soil the more resistance it offers to the passage of the current. Wasting of the lead in the joints also leads to leakage and eventual failure of the pipe by the blowing out of the lead.

Pictures from Nature's Garden; Stories from Life in Wood and Field. By H. W. Shephard Walwyn. Pp. 311; illustrated. (London: John Long.) Price 6s.

TO the naturalist the chief point of interest in this little volume is undoubtedly centred on the illustrations, which are reproductions from photographs by the author. Among these we may specially refer to one of a dormouse asleep (p. 34), which, so far as we know, is unique, and certainly of great interest. The photograph of a sleeping bat, apparently a pipistrelle (p. 27), is likewise excellent, as is also one of a Japanese or Manchurian sika-deer, with the white "chrysanthemums" on the buttocks fully expanded (p. 306). In both these instances it is a pity that the names of the species depicted are not given. As to the text, we venture to think even the author himself would admit that it is scarcely of a nature demanding detailed notice in the columns of this journal.

R. L.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

On Correlation and the Methods of Modern Statistics.

IN NATURE of August 29 (p. 461) appeared some account of a discussion at the British Association on modern methods of treating statistics. The following paragraph occurs:—

"Mr. A. R. Hinks, who was somewhat sceptical as to the general applicability of the new methods, inquired what meaning could be attached to the value 0.3 of the correlation coefficient in such cases as $y = \log x$. He also gave an example in which questionable conclusions had been arrived at by the method, the reason being that certain groups of stars had been studied for special purposes, while others had been neglected."

The obvious answer to the first part of Mr. Hinks's inquiry is that no meaning could be attached to the particular value 0.3 unless we were told what part of the relation $y = \log x$ it referred to, and then it would have a quite definite but limited meaning. Every statistician trained in modern methods in the case of statistics belonging to new material plots his regression lines and tests the approach to linearity in his material. When he finds any orderly system, but no approach to linearity, he naturally tests the dependence of his characters by the correlation ratio. That test applied to Mr. Hinks's case of two absolutely correlated variables $y = \log x$ gives unity or perfect correlation, as we might anticipate.

Writing to Mr. Hinks for further information as to the bearing of the second part of his criticism, he tells me that the report is too brief to be intelligible, and owing to his courtesy I have been provided with a fuller report of his speech, in proof, for the Journal of the Royal Statistical Society. The "questionable conclusions" reached by the method of correlation to which he refers occur in "a recent paper published under the auspices of Prof. Karl Pearson" (Winifred Gibson, *Monthly Notices R.A.S.*, vol. lxvi, p. 445), and the special point to which Mr. Hinks refers is the result reached by Miss Gibson for the relationship between parallax and photometric magnitude. The point is an extremely interesting one, and that must be my excuse for ventilating the matter in the pages of NATURE. Mr. Hinks makes two criticisms, the first as to method and the second as to matter.

First, as to Method.—Mr. Hinks says that if the stars were uniform in size and brilliancy, the parallax and magnitude relation would be logarithmic, and consequently the coefficient of correlation would not be unity. "He understood that in such a case it was proper to use correlation ratios, but not correlation coefficients. If this was so, he would ask the exponents of modern methods to erect a very large and conspicuous danger signal to keep astronomical statisticians from falling into such a trap."

Now Miss Gibson's paper was, I believe, the first to place modern statistical methods before astronomers, and the statistician may well make slips in a new field. But as to method; what does she actually do? She calculates (1) the correlation coefficient between magnitude and parallax, (2) the correlation coefficient between parallax and amount of light, and finding both small, she plots (3) the regression line, and calculates the correlation ratio, and as this takes a value of 0.4, she points out that the correlation coefficient is not the suitable measure in this case. In other words, she puts up the very danger signal which Mr. Hinks requires! I fail entirely to see how Mr. Hinks's remarks as to the logarithmic relation apply to Miss Gibson's work. She has treated the matter correctly from the statistical standpoint, and her paper shows that she was fully aware of the possibilities attached to a logarithmic relationship, which she more than once cites.

Secondly, as to Matter.—Here Mr. Hinks is on safer ground, but one in which I fancy astronomers have been guilty of a considerable amount of circular reasoning.

They start from the hypothesis that magnitude is very closely related to parallax, and when the statistician shows that the best determined parallaxes show no continuous relationship between parallax and magnitude, they turn

round and say: "Yes, but our stars were selected because they had big proper motions." They thereby screen entirely the fact that the fundamental hypothesis that the brighter stars are much the nearer as yet awaits statistical demonstration. Miss Gibson worked on the seventy-two stars given by Newcomb, as of fairly well-ascertained parallax. Mr. Hinks says that the peaks in Miss Gibson's parallax-magnitude curve are in two out of three cases due to selection of certain stars because of their exceptional proper motion. Now this naturally leads us to inquire why the stars with magnitudes about 2 and again about 6 were not selected by their proper motions, but those about 4 and 5 and again those about 7 to 9 were. Further, there is a fundamental point which Mr. Hinks has to meet. Statistically to produce large effect on the correlation of two quantities by selection, the character used for selection must have high correlation with both. In other words, if the selection of stars by proper motion is to pull down the assumed high relationship between magnitude and parallax to a low value, not only must magnitude and proper motion be highly correlated, but proper motion and parallax. Now these correlations have been carefully investigated, and we know what they are—they are such as to influence, but not very much influence, any relation between parallax and magnitude. Now I think the circular process of the reasoning I have referred to will be visible. It runs as follows:—

There is a high relationship between parallax and magnitude; it is not statistically evident, because the parallax stars have been chosen on account of proper motion; this involves a very high correlation between proper motion and magnitude; a very moderate correlation, but not a high correlation, does exist. Shall we say that these stars have been selected by reason of something else?

Surely the hypotheses of high relationships between magnitude and parallax and proper motion are of sufficient importance to deserve *proof*, rather than to be taken as axiomatic? If the reader will examine Table III. of vol. ii. of the Yale Observatory Memoirs (p. 202), which has reached me since Miss Gibson's memoir appeared, he will find the parallaxes of 163 stars, differing widely from Newcomb's series, dealt with, but the correlation ratio (0.28) is even less than that (0.40) found for Newcomb's material. The specious appearance of descending magnitude with the parallax groups is almost wholly due to the first group of large negative parallaxes, which seems merely to signify that large errors of parallax are more common with faint stars. I take it that 0.35 is an excessive value for the relationship between proper motion and magnitude.¹ Against these merely moderate relationships I would place those connecting spectral class and magnitude, which can be as high as 0.69; and, again, the fact that colour and magnitude are related at least as closely as parallax or proper motion and magnitude; and I would venture to ask whether it may not be that the mass, the chemical constitution, and the life-history of a star, as evidenced in its spectroscopic character, have sensibly more to do with the magnitude than its mere distance? After all, almost any theory of distribution of stellar mass, position, and motion would lead us to expect a relatively small correlation between proper motion and distance, sensible, indeed, on the average of great numbers, but as ineffectual for the purpose of selecting an individual as choosing an able assistant by a preliminary measurement of his head.

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Plague Prevention in India.

HIS MAJESTY'S recent letter on this subject to the Government of India was well designed to stimulate the Government to more active efforts against the disease, but has been followed by pronouncements from it which do not suggest any strong hope that that object will be attained. In these pronouncements the Government of India issues advice to the heads of local administrations regarding the methods of dealing with plague—a familiar matter; but,

¹ Dr. A. Lee has worked out for me the correlation ratio for more than 300 northern and 300 southern stars in Boss's catalogue. For the southern stars the correlation of magnitude and proper motion is insignificant, for the northern stars it is much less than in the above cases, and would be insignificant but for a group of four stars with magnitude less than 1.5. These points will be brought out in a forthcoming memoir.

as the *Pioneer Mail* of August 23 remarks:—"Nothing is said about finding the money for the proper carrying out of these recommendations." There is, moreover, another defect which suggests further doubts. The whole of the edict is filled with injunctions to avoid "any action which excites the opposition of the people." Now as almost every sanitary action, from cleansing the backyard upwards, does excite the opposition of a large percentage of the people, this policy means, I fear, not the advancement, but the abandonment of any large-scale operations against plague in India.

Obviously, in epidemics as in war, the superstitions, fancies, and trifling objections of the individual must give way to the public interest. The only alternative is widespread death. To use compulsion may be unpleasant to a Government, but it is a duty to use it. If a Government does not use compulsion it must be held responsible for the fatal results. In my experience, popular opposition to sanitary measures is not really a serious matter. The strength of it is in inverse proportion to the capacity and resolution of the authorities. What opposition has occurred in this case has, I think, been created largely by the original weakness which gave in to it. It is useful to compare the despotic and successful sanitary methods of the Americans with the feeble and futile system adopted in India.

It is difficult to see the object of this pronouncement of the Government of India, which will apparently tend only to hamper executive officers in the performance of their duties. We must infer that the recommendations were made chiefly with a view to please the numerous pseudo-philanthropists who exert so much evil influence in the councils of the great empire of Letspretendia.

Those who wish to ascertain what is really being done against plague in India, compared with statements in Parliament, should consult Prof. Simpson's recent lecture in the *Lancet*, especially that of July 27. According to him, the Government has spent only about 1,500,000l. on plague prevention, against 17,000,000l. on famine relief, and this in spite of the fact that 20,000,000l. surplus revenue has been collected during the same period (since 1896).

I have not seen any complete discussion of the actual measures which should now be taken against plague in India; but think that the following will be approved of by most hygienists who have considered the matter:—

(1) The whole of the plague administration should be centralised, removed from the hands of the civilians who have hitherto obtained such poor results, and put in those of experts, on the American system. This administration should allot the expenditure, indicate the researches, direct the practical measures, publish monthly reports showing exactly what it is doing, and be held responsible for the results of its work.

(2) The expenditure on plague research should be increased ten-fold. The present commission is doing excellent work, but the investigations can be obviously enlarged so as to include many new fields, such, for instance, as the search for a specific therapeutic agent, on the lines of work now being done in connection with sleeping sickness.

In the message of the Government of India there is no sufficient statement on either of these important points. We may rest assured that if they are not included the plague measures will remain as ineffective as before.

RONALD ROSS.

The University, Liverpool September 16

Root-action and Bacteria.

IN NATURE of July 18 (p. 270) I mentioned that I had proved the excretion from plant roots of a toxic substance. This substance proves to be alkaloidal in nature, and is precipitated, in addition to the usual alkaloidal reagents, by most of the substances in use as artificial manure. Potassium sulphate and chloride appear to be the most complete precipitants of all the reagents so far tried. They appear to precipitate the substance in the form of a base—a white amorphous powder. The amount excreted is by no means negligible, and *Sesamum indicum*, indeed, in its early stages at least, appears to excrete more solid matter than it builds up in its own substance.

Details are given in a Memoir of the Agricultural Department of India.

F. FLETCHER.

Ghizeh, Egypt, August 22.